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FINITE ELEMENT ANALYSIS OF MECHANICAL PROPERTIES OF REINFORCED E-GLASS FIBER

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ABSTRACT

In this paper work, a new combination of composite material is being prepared by the reinforcement of e-glass fibre with epoxy resins by the addition of special soot material with wt % as 0%, 0.1%, 0.5% and 1.0% by compression moulding methodology. Finite element analysis for the composite material with addition of special soot particles was carried out for various loading conditions and results were obtained. Error analysis was also done. It was seen that inclusion of reinforcement contributed for a significant in mechanical properties. Results were found to correlate with experimental results.

KEYWORDS: E-Glass Fiber, Compression Moulding & Finite Element Analysis

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Original Article

INTRODUCTION

The six commonly identified processes which are namely pyrolysis, nucleation, coalescence, surface growth, agglomeration, and oxidation occurs in the formation of soot particles that was obtained from the liquid- or vapor-phase hydrocarbons and in the process when it goes back to the gas-phase. Polycyclic aromatic hydrocarbons belong to the category of hydrocarbons – the carbon and hydrogen contents in the organic compounds are made up of multiple aromatic ring whose basic form like naphthalene, anthracene and phenanthrene are comprised of two and three aromatic rings respectively.

LITERATURE REVIEW

Chetan Kulkarni et al [1] the material which are used in automobile, aviation and mineral processing applications should be light in weight and have the load withstanding capacity and progressively evolved into the new phase of Metal Matrix Composites (MMCs) which are customized by the addition of the handpicked reinforcements.

Jingwei He et al [4] prepared a radio-opaque E-glass Fiber-Reinforced Composite (EFRC) by synthesis of iodine by the process of methacrylate monomer methods. A Resin Impregnating Solution (RIS) is prepared from the systhesis process of iodine in which the resultant sample that contains methacrylate monomer 2-hydroxy-3-methacryloyloxypropyl (2, 3, 5- triiodobenzoate) (HMTIB) by mixing it in different mass ratio with Bis-GMA and

MMA, and also another Resin Impregnating Solution (RIS) is being prepared without the control of HMTIB was used. In the last stage of photo initiation system CQ and DMAEMA were added. The radio-opaque EFRC was fabricated by wetting the E-glass fiber thoroughly in Resin Impregnating Solution (RIS). Finally, the FT-IR analysis was investigated by the Degree of double bond conversion (DC).

S. Dariushi and M. Sadighi [2] the fiber metal laminate (FML) plates which belong to a new family of the sandwich structures that possess advanced properties over metals and fiber reinforced composites were compared with the bending properties of similar sandwich beams with fibrous composite faces and for the experimental purpose. Six (6) different groups of specimen which possessed different layer arrangements from one and another were tested.

P. Soltani et al [7] to accurately analyze and evaluate the tensile properties of GLARE (Glass Fiber Reinforced Aluminium Laminates) a finite element modelling was developed to predict the stress–strain response and deformation behavior based on numerical simulations and nonlinear tensile behavior in the in-plane loading conditions was investigated and the analysis was carried out using ANSYS finite element package.

Puttaswamaiah. S et al [5] hand layup technique with and without fibres (Neat/pure matrix) was used to fabricate PMC laminates as a replacement for conventional materials in various applications. For the mechanical property evaluation of Epoxy/glass; Polyester/glass the mechanical properties of PMC's were improved by adding Thecasio4 filler material as an additive for the adhesive material, of epoxy resin in the bi woven (WSM) glass fiber reinforced with polyester.

Esmael Adem et al [3] the specimen preparation technique, carrying out the experimental evaluation for finding out the mechanical properties and finally to make the observation of the sample prepared by using Scanning Electron Microscopy (SEM) to investigate about the inhomogeneity, fracture behavior and porosity for the E-glass/Epoxy & E-glass/Polyester composite.

M. M. Shokrieh and A. Karamnejad [6] the first-order shear deformation theory was used to derive the nonlinear equations of motion which were solved by the finite-difference method those were in line with the new mark time integration scheme which is to be implemented for the laminated composite plate under blast loading. In order to achieve the strain rate effects, the rules which were impregnated for the material property degradation were modified.

A. Chennakesava Reddy [8] an air bottle made of E-glass/epoxy composite with a load bearing capacity of 40 MPa was designed to be used in military system whose hoop and helical winding layers were of thickness 3.6 mm and 3.013 mm respectively which were validated through finite element analysis showed results in which the matix splitting happened along the fibers and also the fibers were found broken when tested at a pressure of 60Mpa.

R. Praveen Kumar et al [9] the fiber reinforced with hybrid composites which comprises of two or more fiber in a prescribed matrix system. In this study, hemp fiber, silicon carbide and unidirectional glass fiber reinforced epoxy composites were prepared by varying the silicon carbide content from 0% to 9% with different weight ratio. The composites of silicon carbide (with 3%, 6% & 9% and without silicon carbide) hemp fiber, unidirectional glass fiber shows that the composite with silicon carbide shows the better result than without silicon carbide.

A. R. Sivaram et al [10] Particulate reinforced graded material composites are advanced materials, which were found to have the reinforcement particles whose fraction of their volume varies continuously. The microstructures of these composites are not uniform. This paper studies the hardness of Aluminium alloy in which Zirconium Di-oxide (ZrO_2) particles are reinforced. Stir casting technique is used to synthesis this composite. The inclusion of reinforcement particles

would enhance the hardness of the alloy.

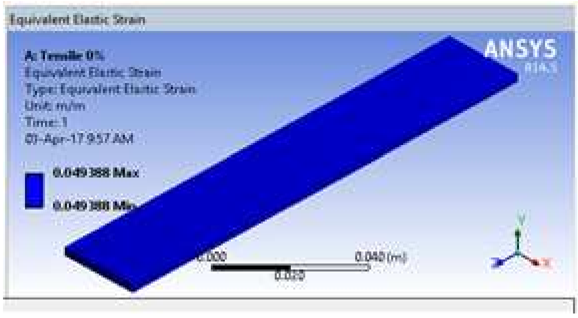
FEA ANALYSIS

For the FEA analysis, the size of the specimen is taken as per the following dimensions given in table 2 and fed in ANSYS.

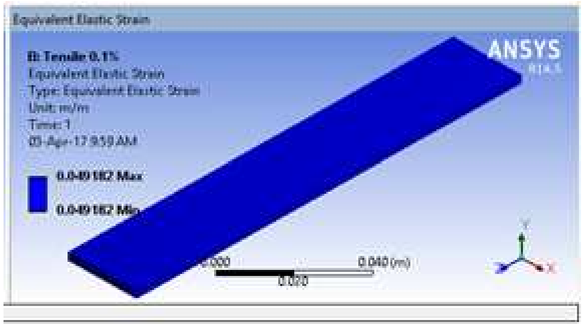
Table 1: ASTM Standard Dimensions

Title	Length(mm)	Breath(mm)	Thickness(mm)
Tensile specimen	250	25	3
Flexural specimen	125	13	3

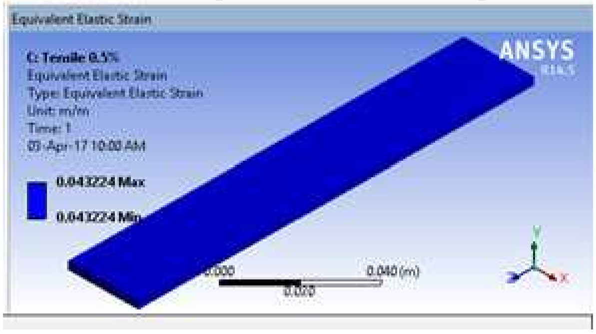
For the soot particles percentage which was taken as 0%, 0.1%, 0.5%, 1% the obtained tensile strength for the given specimen were found to be 220.35, 230.67, 222.67, 189.33 MPa and the flexural strength for the given specimen were found to be 328.45, 353.65, 325.31, 300.77 MPa respectively which are shown in figure 8 and figure 9.



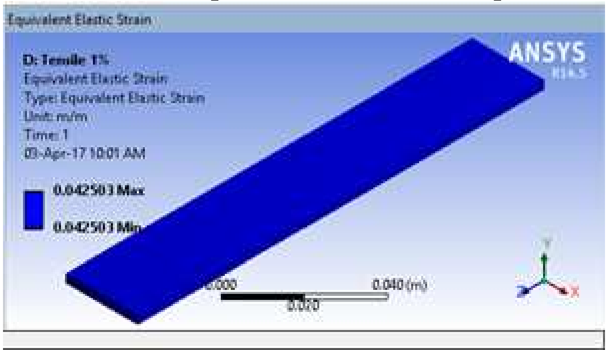
(a) Tensile specimen with 0% Soot particles



(b) Tensile specimen with 0.1% Soot particles

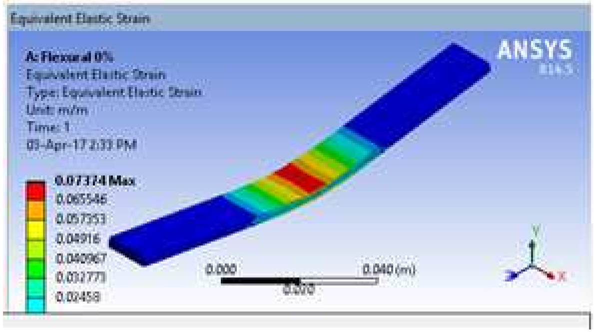


(c) Tensile specimen with 0.5% Soot particles

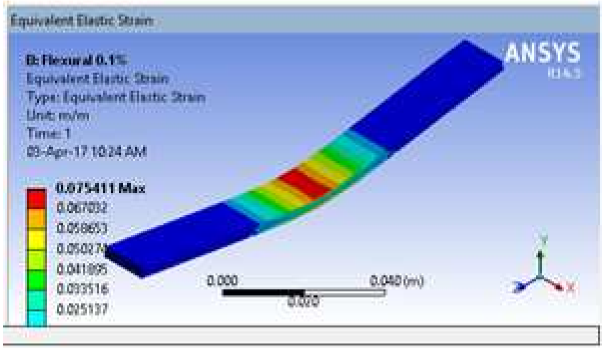


(d) Tensile specimen with 1.0% Soot particles

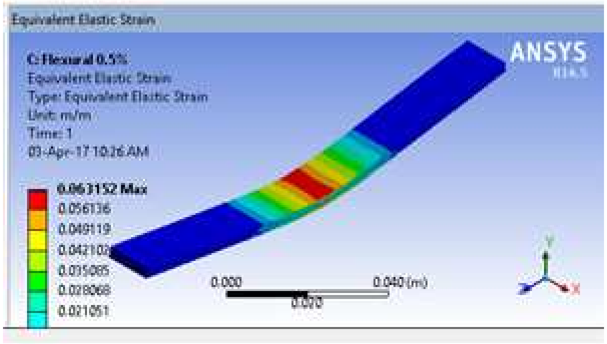
Figure 1: Tensile Specimen with Varying Percentage of Soot Particles.



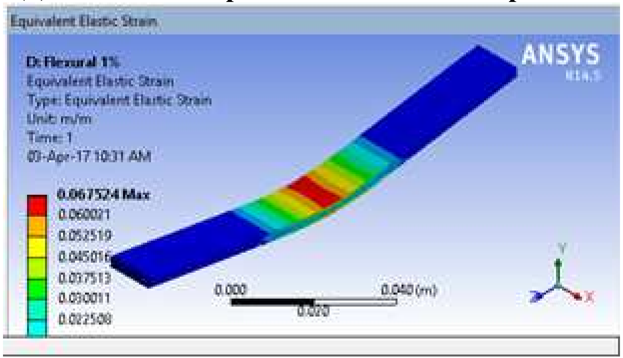
(a) Flexural specimen with 0% Soot particles



(b) Flexural specimen with 0.1% Soot particles



(c) Flexural specimen with 0.5% Soot particles



(d) Flexural specimen with 1% Soot particles

Figure 2: Flexural Specimen with Varying Percentage of Soot Particles.

The table 2 explains the comparison between the experimental and the analysis for various proportions of the particular soot particles.

Table 2: Comparison of the Experimental and Analysis Results

Soot Particles (%)	Tensile Strength			Flexural Strength (MPa)		
	Experimental (MPa)	Analysis (MPa)	Error (%)	Experimental (MPa)	Analysis (MPa)	Error (%)
0	220	220.35	0.15	334	328.45	1.66
0.1	230	230.67	0.29	360	353.65	1.76
0.5	222	222.67	0.30	331	325.31	1.71
1.0	190	189.33	0.35	307	300.77	2.53

CONCLUSIONS

From the Finite Element Analysis carried out for the e-glass and epoxy composite reinforced with the soot particles, it was seen that the addition of soot particles resulted in significant improvement in the mechanical properties namely the tensile strength, flexural strength and water absorption capacity. The soot particles have enhanced properties which resulted in the improvement in mechanical properties.

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